AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently amended) A method of simulating a system, comprising:

establishing equations modeling the system using terms having characteristics encapsulated within the terms;

performing symbolic processing on the established equations for simplification, wherein the symbolic processing includes utilizing the Panetlides algorithm to reduce the established equations and eliminate an integral, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

performing system processing for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations~~.~~; and

generating an output that simulates the system.

2. (Original) The method of claim 1, wherein the stage of defining equations further includes:

defining equations modeling the system using terms selected from one or more basic terms, composite terms, or collection terms.

3. (Original) The method of claim 1, further including:

extending a library of terms by defining new term classes, wherein term classes define objects having characteristics encapsulated within the objects.

4. (Original) The method of claim 1, further including:

defining a term group including one or more terms having related functionality;

evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group;

storing the result of the evaluation for each of the one or more terms within the term group; and

recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

5. (Currently amended) The method of claim 1, wherein ~~the symbolic processing stage further includes reducing the established equations,~~ utilizing the Pantelides algorithm~~,~~ includes reducing the established equations to a system of equations having a differential-algebraic system of equations index of at most one.

6. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

assigning equations to variables that have non-zero partial derivatives; and

differentiating the remainder of the equations.

7. (Previously presented) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

approximating an algebraic derivative for those equations that cannot be symbolically differentiated.

8. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

symbolically integrating equations that cannot be assigned.

9. (Original) The method of claim 5, wherein utilizing the Pantelides algorithm further includes:

differentiating equations that add output derivates and integrating equations that add output integrals.

10. (Currently amended) The method of claim 5, wherein eliminating an integral~~utilizing the Pantelides algorithm~~ further includes:

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship.

11. (Currently amended) The method of claim 10, wherein eliminating an integral further includes:

~~assigning a preferred integration location rank to one or more integrals;~~

utilizing the preferred integration location rank, assigning integrals to equations; and

eliminating the integration of assigned or solved integral variables.

12. (Currently amended) The method of claim ~~11~~1, wherein assigning a preferred integration location rank further includes:

assigning a preferred integration location to one or more integrals, ~~the~~a user assigned preferred integration location being given the highest available preferred integration location rank;

assigning a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

13. (Original) The method of claim 12, wherein the assigned preferred integration location is assigned by a user.

14. (Original) The method of claim 12, wherein the assigned preferred integration location rank is assigned by a component developer.

15. (Original) The method of claim 12, wherein utilizing the preferred integration location ranks to assign integrals to equations further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank, and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

16. (Original) The method of claim 15, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

17. (Previously Presented) The method of claim 1, wherein the stage of performing system processing includes:

establishing an initial condition system using the first set of equations and establishing a transient system using the second set of equations.

18. (Previously presented) The method of claim 1, wherein processing a first set of equations includes:

processing a first set of equations including equations modeling the system and user-defined and component-defined initial condition constraints.

19. (Previously presented) The method of claim 1, wherein performing system processing includes:

performing the system processing on the first set of equations and the second set of equations independently and in parallel.

20. (Original) The method of claim 1, wherein system processing further includes:

replacing alias variables;

partitioning the equations into blocks;

tearing the blocks;

sorting the blocks; and

compressing equation terms.

21. (Original) The method of claim 20, wherein tearing the equations includes:

identifying block variables in the equations in the block in which the block variables appear linearly with constant coefficients;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

determining the solvability of the nonlinear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; and

scanning the solved variables for identification of variables that are independent and may be removed from the block.

22. (Original) The method of claim 20, wherein block sorting further includes:

defining and identifying the blocks as static blocks, dynamic blocks, or output blocks;

removing the static blocks from a list of blocks; and

removing the output blocks from the list of blocks.

23. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of simulating a system, the method comprising:

defining equations modeling the system using terms having characteristics encapsulated within the terms;

performing symbolic processing on the established equations for simplification, wherein the symbolic processing includes utilizing the Panetlides algorithm to reduce the established equations and eliminate an integral, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

performing system processing for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations~~.~~; and

generating an output that simulates a system of interest based on the processed equations.

24. (Original) The machine-readable storage medium of claim 23, wherein the stage of defining equations further includes:

defining equations modeling the system using terms selected from one or more basic terms, composite terms, or collection terms.

25. (Original) The machine-readable storage medium of claim 23, further including:

extending a library of terms by defining new term classes, wherein term classes define objects having characteristics encapsulated within the objects.

26. (Original) The machine-readable storage medium of claim 23, further including:

defining a term group including one or more terms having related functionality;

evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group;

storing the result of the evaluation for each of the one or more terms within the term group; and

recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

27. (Currently amended) The machine-readable storage medium of claim 23, wherein ~~the symbolic processing stage further includes reducing the established equations,~~ utilizing the Pantelides algorithm~~,~~ includes reducing the established equations to a system of equations having a differential-algebraic system of equations index of at most one.

28. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

assigning equations to variables that have non-zero partial derivatives; and

differentiating the remainder of the equations.

29. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

approximating an algebraic derivative for those equations that cannot by symbolically differentiated.

30. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

symbolically integrating equations that cannot be assigned.

31. (Original) The machine-readable storage medium of claim 27, wherein utilizing the Pantelides algorithm further includes:

differentiating equations that add output derivates and integrating equations that add output integrals.

32. (Currently amended) The machine-readable storage medium of claim 27, wherein eliminating an integral~~utilizing the Pantelides algorithm~~ further includes:

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship.

33. (Currently Amended) The machine-readable storage medium of claim ~~32~~1, wherein eliminating an integral further includes:

~~assigning a preferred integration location rank to one or more integrals;~~

utilizing the preferred integration location rank, assigning integrals to equations; and

eliminating the integration of assigned or solved integral variables.

34. (Currently amended) The machine-readable storage medium of claim ~~33~~23, wherein assigning a preferred integration location rank, further includes:

assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

35. (Original) The machine-readable storage medium of claim 34, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

36. (Original) The machine-readable storage medium of claim 35, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

37. (Previously presented) The machine-readable storage medium of claim 23, wherein the stage of performing system processing includes:

establishing an initial condition system using the first set of equations and establishing a transient system using the second set of equations.

38. (Previously presented) The machine-readable storage medium of claim 23, wherein processing a first set of equations includes:

processing a first set of equations including equations modeling the system and user-defined and component-defined initial condition constraints.

39. (Previously presented) The machine-readable storage medium of claim 23, wherein performing system processing includes:

performing the system processing on the first set of equations and the second set of equations independently and in parallel.

40. (Original) The machine-readable storage medium of claim 23, wherein system processing further includes:

replacing alias variables;

partitioning the equations into blocks;

tearing the blocks;

sorting the blocks; and

compressing equation terms.

41. (Original) The machine-readable storage medium of claim 40, wherein tearing the block includes:

identifying block variables in the equations in the block in which the block variables appear linearly with constant coefficients;

solving nonlinear integration equations for their respective integrals;

determining the solvability of the nonlinear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations;

solving the linear equations; and

scanning the solved variables for identification of variables that are independent and may be removed from the block.

42. (Original) The machine-readable storage medium of claim 40, wherein block sorting further includes:

defining and identifying the blocks as static blocks, dynamic blocks, or output blocks;

removing the static blocks from a list of blocks; and

removing the output blocks from the list of blocks.

43. (Currently amended) A method of simulating systems, comprising:

symbolically processing a set of equations, including:

assigning a portion of the set of equations to variables that have non-zero partial derivatives;

differentiating the remainder of the set of equations;

approximating an algebraic derivative for those equations that cannot by symbolically differentiated;

symbolically integrating equations that cannot be assigned;

differentiating equations that add output derivates and integrating equations that add output integrals; ~~and~~

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

generating a system for simulation using the symbolically processed set of equations~~.~~; and

generating an output that defines a simulated system of interest.

44. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of simulating systems, the method comprising:

symbolically processing a set of equations, including:

assigning a portion of the set of equations to variables that have non-zero partial derivatives;

differentiating the remainder of the set of equations;

approximating an algebraic derivative for those equations that cannot by symbolically differentiated;

symbolically integrating equations that cannot be assigned;

differentiating equations that add output derivates and integrating equations that add output integrals; ~~and~~

eliminating an integral as each symbolically differentiated or integrated equation eliminates a numeric integration, such that the integral is converted to an algebraic variable by eliminating the derivative or integral relationship, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

generating a system for simulation using the symbolically processed set of equations~~.~~; and

generating an output that simulates a system of interest.

45. (Currently amended) A method of eliminating an integral in a Pantelides algorithm performed by a computer-based application that simulates a system, comprising:

assigning a preferred integration location rank to one or more integrals;

utilizing the preferred integration location rank, assigning integrals to equations;~~and~~

eliminating the integration of assigned or solved integral variables~~.~~ and;

generating an output that simulates a system of interest based on the equations.

46. (Original) The method of claim 45, wherein assigning a preferred integration location rank, further includes:

assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

47. (Original) The method of claim 46, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

48. (Original) The method of claim 47, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

49. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of eliminating an integral in a Pantelides algorithm used by an application that simulates a system, the method comprising:

assigning a preferred integration location rank to one or more integrals;

utilizing the preferred integration location rank, assigning integrals to equations;-

~~and~~

eliminating the integration of assigned or solved integral variables; and;

generating an output that defines a simulated system.

50. (Original) The machine-readable storage medium of claim 49, wherein assigning a preferred integration location rank, further includes:

assigning, by a user, a preferred integration location to one or more integrals, the user assigned preferred integration location being given the highest available preferred integration location rank;

assigning, by a component developer, a preferred integration location rank, wherein the preferred integration location rank has a lower rank than the user defined preferred integration location rank; and

assigning all other integration locations a default lowest rank.

51. (Original) The machine-readable storage medium of claim 50, wherein utilizing the preferred integration location ranks to assign integrals to equations, further includes:

identifying integral variables that appear linearly and nonlinearly in the integral equations;

establishing a current preferred integration location rank at a default setting;

assigning each integral equation an integral variable that has a preferred integration location rank of less than the current preferred integration location rank and, if possible, appears linearly in the equation; and

repeating the previous three stages after increasing the current preferred integration location rank until a maximum preferred integration location rank has been exceeded.

52. (Original) The machine-readable storage medium of claim 51, further including:

solving each integral equation that is assigned an integral that appears linearly in it;

substituting the solved value into other equations; and

if due to substitutions, an one of the assigned variables is no longer in the equation, assign another integral with minimum integration rank to the one of the assigned variables.

53. (Currently amended) A method of simulating systems, comprising:

performing a tearing process on a set of equations, including:

identifying block variables in the equations in a block in which the block variables appear linearly with constant coefficients;

determining the solvability of the nonlinear equations;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; ~~and~~

scanning for solved for variables for identification of variables that are independent and may be removed from the block; ~~and~~

generating a system for simulation using the processed equations~~.~~; and

generating an output that simulates a system of interest based on the processed equations.

54. (Currently amended) A machine-readable storage medium having stored thereon machine executable instructions, the execution of said instructions adapted to implement a method of simulating systems, the method comprising:

performing a tearing process on a set of equations, including:

identifying block variables in the equations in a block in which the block variables appear linearly with constant coefficients;

solving nonlinear integration equations for their respective integrals;

solving the linear equations;

determining the solvability of the nonlinear equations;

solving the nonlinear equations utilizing iterates and block variables solved from the linear equations; ~~and~~

scanning for solved for variables for identification of variables that are independent and may be removed from the block~~; and~~

generating a system for simulation using the processed equations~~.~~; and

generating an output that simulates a system of interest based on the processed equations.

55. (Currently amended) A method of simulating a system, comprising:

establishing equations modeling the system using terms having characteristics encapsulated within the terms;

performing symbolic processing on the established equations for reducing the number of terms in the equations, wherein the symbolic processing reduces the established equations by eliminating an integral, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

performing system processing for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations~~.~~; and

generating an output that defines the simulated system based on the processed equations.

56. (Original) The method of claim 55, further including:

defining a term group including one or more terms having related functionality;

evaluating each term within the term group upon an initial request for evaluation of any of the one or more terms within the term group; and

storing the result of the evaluation fro each of the one or more terms within the term group.

57. (Original) The method of claim 56, further including:

recalling the stored value of the evaluated one or more terms from the term group upon a subsequent request for evaluation of the one or more terms, without performing the evaluation stage.

58. (Currently amended) A method of simulating a component, comprising:

establishing equations modeling the component using terms having characteristics encapsulated within the terms;

performing symbolic processing on the established equations for simplification, wherein the symbolic processing reduces the established equations by eliminating an integral, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals; ~~and~~

performing system processing for efficient simulation, wherein performing system processing includes processing a first set of equations including equations modeling the system and initial condition constraints and processing a second set of equations including equations modeling the system and numeric integration equations~~.~~; and

generating and storing an output defining the simulated system based on the processed equations.

59. (Currently amended) A method of simulating a system, comprising:

establishing equations modeling the system;

performing symbolic processing on the established equations for simplification, wherein the symbolic processing reduces the established equations by eliminating an integral, wherein eliminating an integral includes assigning a preferred integration location rank to one or more integrals;

establishing a first set of equations including equations modeling the system and initial condition constraints;

establishing a second set of equations including equations modeling the system and numeric integration equations that constrain integrated variables; ~~and~~

processing the first and second sets of equations independently and in parallel, to generate initial condition and transient solutions~~.~~; and

generating and storing an output defining the simulated system based on the processed equations.

60. (Previously presented) The method of claim 59, wherein establishing equations modeling the system comprises establishing component equations, connectivity equations, and boundary condition equations; and wherein each of the first and second set of equations includes component, connectivity, and boundary condition equations.